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Application No. 10/734,213
Amendment dated February 5, 2007
Reply to Office Action of October 3, 2006

Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims

1. (currently amended) A method for providing a gas turbine compressor impeller, the method comprising the steps of:

- a. forging IMI_834 titanium to provide an impeller blank having a back face and an axis of rotation;
- b. forging a stump portion on the impeller blank, concentric with the axis of rotation, the stump portion extending from the back face;
- c. providing a metal alloy stub shaft; and
- d. assembling the impeller blank to the stub shaft in an axially end-to-end relationship by friction welding the stub shaft to the stump portion, concentric with the stump portion.

wherein the step of forging the stump portion includes ensuring no extrusion of the stump portion occurs during said forging of the stump portion.

2. (currently amended) The method of claim 1 ~~further comprising wherein the~~ step of ensuring no extrusion occurs includes the step of providing a billet for use in said forging steps, the billet having a diameter substantially the same as a diameter of said stump portion.

3. (currently amended) The method of claim 1 wherein the stump portion has a height measured from the back face to a stump portion end face, and wherein the height is selected to ~~optimize the mechanical work done on the body while~~

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~~minimizing negative extrusion in the region of the stump portion to thereby provide improved mechanical properties to the body.~~

4. (currently amended) The method of claim 1 wherein the stump portion has a diameter and a height, the height measured from the back face to a stump portion end face, and wherein the step of ensuring no extrusion occurs includes ensuring the height is not greater than the diameter.

5. (currently amended) The method of claim 1 wherein the stump portion has a stump height measured from the back face to a stump portion end face, and wherein the method further comprises the step of determining a minimum clearance height required to provide adequate clearance between the stump height and the back face for accomplishing a weld flash removal step, and wherein the stump portion is forged to have a stump height substantially equal to the clearance height.

6. (original) The method of claim 1 further comprising the steps of heat treating the welded assembly and then de-flashing a weld portion of the welded assembly.

7. (cancelled)

8. (currently amended) A method for making an ~~an impeller-compressor~~ rotor for a gas turbine engine, the method comprising the steps of:

a. forging an ~~compressor impeller~~-blank from IMI_834 titanium alloy, the ~~impeller-blank~~ having an axis of rotation and a stump portion, the stump portion co-axially aligned with the axis of rotation, the stump portion having a height not greater than a diameter of the stump portion to thereby minimize extrusion of the stump portion during said forging;

b. providing a metal alloy component;

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c. axially assembling the component to the ~~impeller-blank~~ in a butt-like fashion by friction welding the component to the stump portion of the impeller-blank, concentric with the axis of rotation, to provide a welded assembly;

d. heat treating the welded assembly to at least relieve a weld zone; and then

e. removing weld flashing from the weld zone;

wherein the step of forging includes forging a substantially extrusion-free stump portion on the blank coaxially with the axis of rotation.

9. (cancelled)

10. (cancelled)

11. (previously presented) The method of claim 1, comprising forming radially extending blades in the blank.

12. (previously presented) The method of claim 11, wherein the step of forming the blades is carried out by machining the blades in the blank.

13. (cancelled)

14. (cancelled)

15. (previously presented) The method of claim 8, comprising forming radially extending blades in the blank.

16. (previously presented) The method of claim 15, wherein the step of forming the blades is carried out by machining the blades in the blank.

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17. (previously presented) The method of claim 16, wherein the component is a stub shaft and the stub shaft is friction weld to a stump portion of the blank and then the blades are machined.

18. (currently amended) A method for providing a gas turbine compressor ~~impeller~~, the method comprising the steps of:

forging IMI_834 titanium billet to provide an ~~impeller-compressor~~ blank having a back face, the billet having a pre-forging effective diameter;

forging a stump portion on the ~~impeller~~-blank, the stump portion extending from the back face, the stump portion having a diameter substantially equal to said effective diameter to thereby minimize extrusion of said stump portion during said forging thereof;

providing a metal alloy stub shaft;

friction welding the stub shaft to the stump portion to provide a welded assembly; and then

machining radially extending blades in the ~~impeller~~-blank.

19. (new) The method of claim 8 wherein the blank is forged from a billet having a pre-forging diameter substantially equal to a post-forging diameter of said stump portion.

20. (new) The method of claim 8 wherein said stump height is selected to be not greater than a height from said blank providing a minimum required clearance to perform said step of removing weld flashing.

21. (new) The method of claim 18 said stump portion has a height not greater than a diameter of said stump portion.

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22. (new) The method of claim 1 further comprising the step of configuring said stub shaft for connection to a main turbine shaft of the gas turbine engine.

23. (new) The method of claim 8 further comprising the step of configuring said stub shaft for connection to a main turbine shaft of the gas turbine engine.

24. (new) The method of claim 18 further comprising the step of configuring said stub shaft for connection to a main turbine shaft of the gas turbine engine.